

Selected aspects of anatomy and biomechanics of the stomatognathic system

(Wybrane zagadnienia z anatomii i biomechaniki układu stomatognatycznego)

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Abstract – The authors characterized the stomatognathic system. They discussed his anatomical structures. They drew attention to the neurophysiological foundations of this system. They characterized the structure and biomechanics of the temporomandibular joint. They agreed on the movements of the jaws in greater detail.

Key words - stomatognathic system, anatomy, neurophysiology, biomechanics.

Streszczenie – Autorzy scharakteryzowali układ stomatognatyczny. Omówili jego anatomiczne struktury. Zwrócili uwagę na neurofizjologiczne podstawy funkcjonowania tego układu. Scharakteryzowali budowę i biomechanikę stawu skroniowo-żuchwowego. Szczegółowiej umówili ruchy żuchwy.

Słowa kluczowe - układ stomatognatyczny, anatomia, neurofizjologia, biomechanika.

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Authors' contributions to the article:

- A. The idea and the planning of the study
- B. Gathering and listing data
- C. The data analysis and interpretation
- D. Writing the article
- E. Critical review of the article
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Accepted for publication: November 30, 2018.

I. STOMATOGNATHIC SYSTEM

Tissues and organs in the organism responsible for the process of receiving and pre-processing of food is called the stomatognathic system. It is not limited to muscular, bone or joint structures in the oral cavity - these are referred to as the masticatory apparatus. These terms are often used interchangeably, but the stomatognathic system is meaningfully broader than the motor system of the masticatory system and also contains nerve structures belonging to the respiratory system, the speech organ and the facial part of the skull [1]. The tasks of the stomatognathic system in addition to the mentioned chewing function also include: expressing emotions, breathing, speech (articulation of sounds), swallowing the chewed food. It is a complex and internally diverse system, closely cooperating in order to achieve such precise activities as speech or chewing [1-3]. The structures that belong to the stomatognathic system are: teeth, craniofacial bones (including the mandible), dental-alveolar connections, masticatory muscles, mimic muscles, tongue muscles, peripheral muscles, temporomandibular joint with its ligaments and capsule, and oral cavity walls. [3-5]

II. NEUROPHYSIOLOGY OF THE STOMATO-GNATHIC SYSTEM

The stomatognathic system¹ is administered by the limbic system in cooperation with the reticular formation², as well as cortical centers responsible for any movements.

¹ The limbic system consists of: nostrils, limbic lobe, bend of the rim, hippocampus bend, sub-focal field, hippocampus, gray incisor, tape-worm bend, dentate gyrus, amygdala, marginal band, transparent septum, curved bend, nucleus accumbens, vault, hill, frontal nuclei, medial nucleus of the thalamus, hypothalamus, mammary gland, midbrain and interconjugal nucleus. Some also include the orbital bends, the ventral part of the striatum and pale knob, the abdominal area of the cap, and the gray matter. Nowadays, the limbic system in the anatomic sense is rather moving away from using the term limbic. The earliest limbic system is functionally associated with olfactory sensations. Another of its functions is the release of some emotions and impulsive behavior - for example, fear and aggression. The limbic system is also responsible for the feeling of hunger, thirst and sex drive. The individual components of the limbic system, however, have diverse physiological tasks. For example, the hippocampus is responsible for the processing of information that reaches us on a current basis (short-term memory), as well as memory processes and emotions, as well as for the consolidation of memory and current information. In turn, the amygdala is responsible for triggering emotions such as joy, satisfaction and euphoria, but also fear. It is also responsible for the so-called emotional memory. The limbic system also controls the hormonal balance. [4-7]

² A reticular or reticular formation extends in the brainstem to the diencephalon via the medulla oblong to the spinal cord. It contains 96 nuclei. The reticular system is primarily a functional concept. This system includes both transmitting and inhibiting neurons, which conduct impulsions using various types of neurotransmitters. The system is responsible for regulating many vegetative activities, affecting cranial nerve nuclei and vegetative centers. Particular parts of the reticular system have different physiological significance, and so the descending part controls the reflex function of the spinal cord, affects the activity of respiratory and circulatory centers, and muscle tone. The part descending in its part the excitatory part - paves or accelerates the conductivity of other neurons, in the inhibitory part - blocks or releases the conductivity of other neurons, in the ascending part - conducts impersonal impulses as a non-specific pathway and controls the activity of motor nerve nuclei, motor nerve nuclei controlling the movement of the knobs eye. Many retaining paths are associated with the reticular system. [4-7]

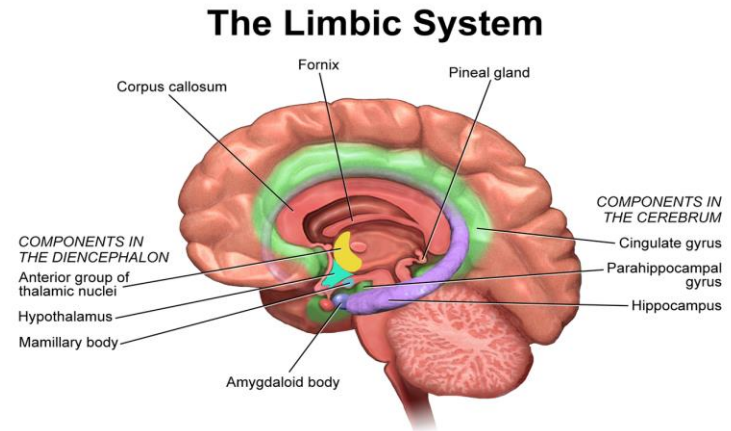


Figure 1. The limbic system [8]

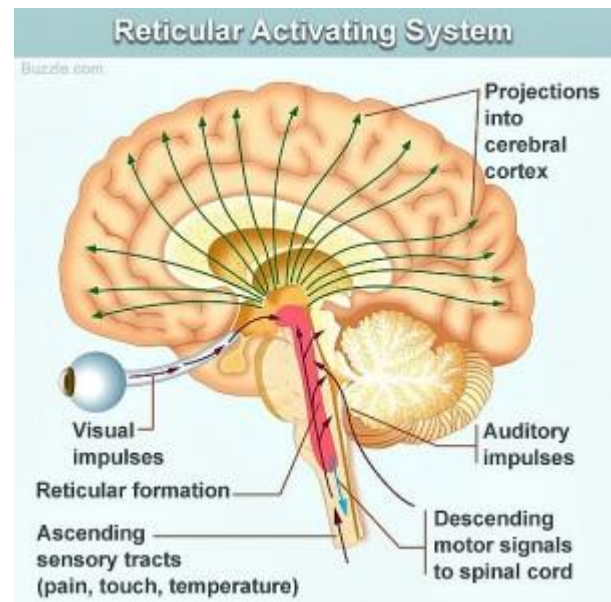


Figure 2. Reticular formation [9]

The nerve impulse route begins with periodontal receptors, pulp, receptors in the temporo-mandibular joints, then runs through the trigeminal nerve branches to its sensory nucleus, and then to the reticular formation. The reticular formation, cooperating with the thalamus and the cerebral cortex, plays an important role (its part in the bulb) and stimulating (its part in the midbrain) on the stomatognathic system. [1,6,7,9,10]

In the habitual position, the mandible is lowered and there is no short-circuit. Just 30 minutes in a day, dental arches remain in the occlusion. On average, the time is spent on swallowing food and swallowing saliva. Of course, patients cultivating short-circuit paraphernalia (including bruxism)

keep the dental arches in the occlusion relation much longer. From this it can be seen that in the case of bruxists or other people regularly performing parafunctions, the participation of the periodontal stimulators is much greater in the regulation of the position of the mandible in the temporomandibular joint than in healthy people [1,2,10].

III. THE TEMPOROMANDIBULAR JOINT - STRUCTURE AND MECHANICS

The temporomandibular joints form the head of the mandible, the articular bottom on the temporal bone, the intra-articular disc, the discular ligaments, and the joint capsule [1,9,11]. (Figure 3.)

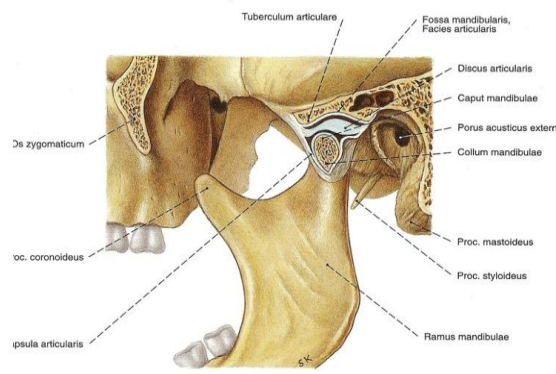


Figure 3. Temporomandibular joints [12]

Movements occurring in the temporomandibular joint are abduction / attachment, protrusion / retrusion, lateral movements.

Chest reversal should take place on a straight vertical track. Lowering the mandible in its first phase consists only of the rotation of the head of the mandible with respect to the temporal bone in the sagittal plane, while in the 1/3 of the range of movement, a joint disk is attached to it. Then the rotation and the sliding of the previous head-puck complex occurs. In the case of blocking the disc, the range is reduced, while its displacement causes disruption of the movement path from straight to arched, oblique, or irregular. [1,2,9,10-15]

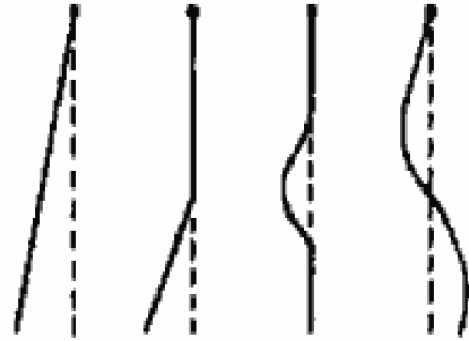


Figure 4. The path of the mandible movement [13]

The physiological range for the movement of the mandibular abdomen is 45 mm [13], although other authors give the standard for women 53 mm, and for men 58 mm [1]. However, most clinicians perceive standards: for women 56-58mm, and for men 54-56mm. On the other hand, different authors agree on the physiological limits of motion, so the range of abduction of 40 mm and less is treated as hypomobility of the joint, whereas 60 mm and more as hypermobility [1,13].

The disc that determines the path of the mandible movement is a collagen structure divided into two non-detached floors. It has a two-concave shape, so as to match the shape of the mandible head as closely as possible. It has trailers for the joint capsule and the head of the mandible in its posterior part. This fact provides him with the possibility of anterior movement, thus enabling the mandibular abduction [3,7].

Movements in the temporomandibular joint depend not only on the tension of muscles moving the mandible, extending the joint capsule, or the position of the articular disc, but also on the impulsion flowing from the reticular formation, dictated by the psycho-vegetative state [1,3,9,13,15].

Temporomandibular joint dysfunctions may be affected by the reduction of the dental arch. However, in young people no subjective symptoms of temporomandibular joint dysfunction are observed, even if the patient has physical symptoms [2,14]. The structure of bone elements of the stomatognathic system does not affect the occlusal force of isometric contraction of the masticatory muscles [3,16]. In the course of bruxism, the contraction force during the episode is four times higher than the average. [3]

IV. REFERENCES

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